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A Pb isotope synthesis of Mississippi Valley-type ores in the midcontinent U.S.A.: trends and ore metal source(s)

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High concentrations of Ga and Ge, two strategic metals vital to modern technology and industry, have been noticed in ores from various Mississippi Valley-type deposits in midcontinent U.S.A. [1]. These deposits also account for a substantial amount of worldwide Pb and Zn resources. A variety of crustal rocks, including basement rocks, shales, and carbonate aquifers, have been suggested as potential source(s) of ore metals [2, 3, 4, 5, 6]. MC-ICP-MS Pb isotope analysis of ores and rocks have been carried out to re-evaluate these source(s). Lead isotope values of ores define two collinear, parallel trends: Tri-State (TS) and Central Missouri (CM) ores are collinear with Southeast Missouri (SM) and Northern Arkansas (NA) ores; Upper Mississippi Valley (UMV) and Illinois-Kentucky (IK) ores are collinear with Central Appalachian (CA), Southern Appalachian (SA), East Tennessee (ET), Central Tennessee (CT), and South-Central Kentucky (SCK) ores (Figs. 1, 2). Ores from Ozark region (CM, SM, TS, and NA districts) are characterized by ^{208}Pb-depleted Pb compared to Pb in UMV, IK, CA, SA, ET, CT, and SCK districts (Fig. 2). Ores from the UMV, SM, IK, NA, TS, CA, and SA define linear trends (Fig. 2), conventionally interpreted to result from mixing of two end-member components or from a single source of Pb with variable Pb isotope compositions [7]. In case of mixing, Chattanooga Shale or sandstone members of Jackfork Sandstone appear to be best candidates for contributing less radiogenic end-member to southern Ozark ores. The slope of linear trend defined by NA and TS ores corresponds to 1.2 Ga. Therefore, an alternative for linear array is involvement of Precambrian basement in supplying ore Pb. Lead isotope ratios of ET, CT, and SCK ores form narrow clusters. ET ores, part of SA region, have ^{208}Pb-enriched Pb compared to CT and SCK ores. Lead isotope signature of CT and SCK ores imply potential mixing between end-member sources originating from Southern Appalachians and Illinois basins.

[1] Bonnet J. (2013); [2] Heyl et al. (1966); [3] Goldhaber et al. (1995); [4] Kesler et al.(1994); [5] Bottoms et al. (2019); [6] Simbo et al. (2019); [7] Tosdal et al. (1999)